source for redirecting the light received from the laser source, a reflective element spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light to the laser source whereby the laser source, the diffractive element and the reflective element cause the light to lase at the wavelength, and a rotatable electrostatic microactuator coupled to the reflective element for rotating the reflective element about a pivot point spaced apart from the microactuator to select the wavelength of the light.

b/0 end

REMARKS

As noted in the Amendment mailed November 15, 2002, the Supplemental Information Disclosure Statement filed July 6, 2001 does not appear to have been considered by the Examiner. A copy of the Supplemental Information Disclosure Statement, as well as a copy of the return postcard from the U.S. Patent and Trademark Office, are enclosed herewith. Applicant requests that the Examiner consider the Supplemental Information Disclosure Statement and acknowledge such consideration in the next Action.

The paragraph beginning on Page 54, line 17 has been amended to make it more readable. The word "reflecting" has been changed to "translating", such change being consistent with the remainder of the paragraph.

Applicants acknowledge that Claims 13 and 31-36 have been allowed and that Claims 23-25 and 39 have been rejected as being dependent upon a rejected base claim, but indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claim.

Claims 21 and 22 have been objected to under 37 C.F.R. §1.75 as being a substantial duplicate of Claims 16, 17 and 20. In this regard, Claim 21 is not a substantial duplicate of Claim 16 as suggested by the Examiner. The combination of Claim 16 includes an optical sensor for sensing "a light beam reflected from one of the diffractive element and the reflective element", while the combination of Claim 21 includes an optical sensor for sensing "the light." The "light beam" of Claim 16 can be produced from "an additional laser source", as provided in Claim 18, or from "the laser source", as provided in Claim 19. In contrast, the antecedent basis for "the light" of Claim 21 is the light of Claim 1. In addition, Claim 21 does not include the limitation "reflected from one of the diffractive grating and the reflective element", which is included in Claim 16. Hence, as can be seen, Claim 21 is not a substantial duplicate of Claim 16. Accordingly, the objection under 37 C.F.R. §1.75 should be withdrawn.

Claim 8 has been rejected to under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 8 has been amended to delete the words "carried by the substrate." With this explanation and amendment, it is assumed that the rejection under 35 U.S.C. §112, second paragraph, will be withdrawn.

Claims 1-9, 14, 15, 18, 26-30, 37 and 38 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Leckel et al. (U.S. Patent No. 6,404,798) in view of Dhuler et al. (U.S. Patent No. 6,428,173). Claims 11 and 12 have been similarly rejected over Leckel et al. in view of Dhuler et al., as applied to Claim 1 above, and further in view of Jerman et al. (U.S. Patent No. 6,998,906), while Claims 16, 17 and 19-22 have been similarly rejected over Leckel et al. in view of Dhuler et al. as applied to Claim 1 above, and further in view of Mattori et al. (U.S. Patent No. 6,081,539) and Claims 26 and 27 have been similarly rejected over Leckel et al. in view of Dhuler et al. as applied to Claim 1 above, and further in view of Broutin et al. (U.S. Patent No. 6,198,757). Reconsideration of these claims is respectfully requested.

Leckel et al. disclose a low noise and wide power range laser source. FIG. 1 of Leckel et al. shows in principle a laser source 5 according to certain art documents cited in the background of the invention. In FIG. 1, a laser gain medium or amplifier 10 provides a first facet 20 which is low reflective and a second facet 30 which is high reflective. The first facet 20 emits a laser beam 50 into an external cavity of the laser source 5. A collimating lens 60 collimates the laser beam 50 to a beam splitter 65 splitting the laser beam 50 into a part 50' and a part 67. The part 50' of the laser beam 50 is directed to an optical grating 70 as a wavelength dependent mirror. The optical grating 70" diffracts the incident beam 50' and a wavelength separated beam 50" is directed back towards the beam splitter 65. The angle of the optical grating 70 with respect to the beam 50" depends on the wavelength to be selected. The optical grating 70 together with the facet 30 of the semiconductor amplifier 10 define the optical resonator of the laser source 5. The beam splitter 65 splits up the returning beam 50" into a beam 50'" towards the gain medium 10 and a beam 80. The laser system 5 provides as output signals the laser beams 67 and 80, coupled out respectively from the beam splitter 65. The output beam 80 can be coupled into a fiber 90, e.g., by means of an optical lens 100. Col. 2, lines 6-25. As a further improvement over the laser source 5 of FIG. 1, either in addition to the provision of the output beam 210 or independent thereof, the laser source 200 of FIG. 2 further provides a mirror 270. Col. 5, lines 31-35. Preferably, the mirror 270 is arranged in a Littman-configuration allowing a mode-hop free wavelength tuning of the laser source 200. In the Littman-configuration, as known in the art, planes through the grating 70, the mirror 270, and the facet 30 substantially intersect in a point 290. Col. 5, lines 48-52.

Dhuler et al. disclose a moveable MEMS mirror structure including a thermal actuator and a mirror having a mirrored surface positioned out of plane relative to the underlying microelectronic substrate surface in both non-actuated and actuated positions. The MEMS mirror structure can also include various latching mechanisms that can be used to hold the mirror in a fixed position, even after the thermal actuator is deactivated. Further, MEMS moveable mirror structures may be disposed in an array and individually controlled to serve various high resolution applications, such as optical switching, optical attenuation, or the like. Dhuler et al. state that as those skilled in the art will appreciate, however, the MEMS moveable mirror structures provided therein may be used advantageously in other applications. Col. 5, lines 36-52. The microactuator of FIG. 1 in Dhuler et al. is a thermal arched beam actuator. The thermal arched beam actuator comprises at least two anchors, for example anchor 32 and anchor 33. Each anchor is affixed to the microelectronic substrate to provide support for the thermal arched beam actuator. Further, the thermal arched beam actuator includes at least one arched beam 35 disposed between at least one pair of anchors. Each arched beam extends between a pair of anchors such that the ends of the arched beam are affixed thereto and the arched beam is held in place overlying the microelectronic substrate. Col. 6, lines 55-65. Dhuler et al. further state that any of the microelectromechanical moveable mirror structures according to that invention can be applied to redirect electromagnetic radiation. The term electromagnetic radiation is defined by Dhuler et al. to include but is not limited to light, laser, radio frequency, infrared, or any other type of electromagnetic radiation that can travel along a path, whether visible or not. If a source directs electromagnetic radiation along a path, a moveable microelectromechanical mirror structure can be deployed to intersect and redirect the path of electromagnetic radiation. Col. 17, lines 35-44.

Claim 1, as amended, is patentable by calling for a single mode tunable laser operable over a range of wavelengths of the type set forth therein having, among other things, at least one microactuator coupled to one of the diffractive element and the reflective element for causing angular movement of such element to permit selection of the single wavelength of the light from the range of wavelengths.

In rejecting Claim 1 over Leckel et al., the Examiner acknowledges that Leckel et al. disclose a laser system that is well-known in the art but do not disclose a micro actuator for providing movement to the mirror to obtain a tunable laser. The Examiner further states that Dhuler et al. disclose in the abstract microelectromechanical structures (MEMS) used for controlling the movement of mirrors and, therefore, that it would have been an obvious at the time the invention was made to combine the moveable microelectromechanical mirror of Dhuler et al. with the laser system of Leckel et al. because it would provide movement to the mirror of Leckel et al. for controlling the retro reflected beam and obtaining a tunable laser.

A proper analysis of the obviousness/nonobviousness of the claimed invention under 35 U.S.C. §103(a) requires consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should carry out the claimed invention; and (2) whether the prior art would also have revealed that in so carrying out the claimed invention, those of ordinary skill would have a reasonable expectation of success. Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure. In re Sernaker, 217 U.S.P.Q. 1, at 5 (Fed. Cir. 1983); and In re Vaeck, 20 U.S.P.Q.2d 1438, 1442 (CAFC 1991).

In the present case, the rejection of the claims under 35 U.S.C. §103 is in error because Leckel et al. fail to provide the requisite suggestion/motivation to provide a laser system of the type called for therein having, among other things, at least one microactuator coupled to one of the diffractive element and the reflective element. The Examiner acknowledges that Leckel et al. fail to disclose a microactuator for providing movement to the mirror to obtain a tunable laser. In addition, however, Leckel et al. fail to disclose any actuator, let alone at least one microactuator coupled to one of the diffractive element and the reflective element.

Similarly, Dhuler et al. do not provide the requisite motivation to add at least one microactuator to a laser system of the type disclosed in Leckel et al. For example, Dhuler et al. do not disclose a laser having a diffractive element as called for in Claim 1. Nor do Dhuler et al. disclose a tunable single mode laser microassembly. Rather, Dhuler et al. merely disclose microelectromechanical structures that include a thermal actuator for substantially linear translation of a mirror. Although Dhuler et al. state that the mirror can be used to redirect electromagnetic radiation, which is stated to include laser, there is no suggestion or disclosure that the Dhuler et al. device is suitable for use in a tunable or other laser for generating laser light.

Even if a microactuator of Dhuler et al. was combined with a device of the type disclosed in Leckel et al., there is no suggestion or disclosure in the prior art that in so carrying out such combination those of ordinary skill would have a reasonable expectation of success. For example, there is no disclosure in Dhuler et al. as to how a microactuator of the type disclosed therein, providing substantially linear movement, could be used for causing angular movement of one of the diffractive element and the reflective element to permit selection of a single wavelength of the light from the range of wavelengths.

In addition to the foregoing, and as can be appreciated by those skilled in the art, the field of microactuator design is still nascent. Contrary to the belief of the Examiner, it cannot be assumed that any particular actuator configuration can be developed or is physically possible. Hence, there is no reasonable expectation that the inclusion of at least one microactuator in a

device of the type disclosed in Leckel et al. would be successful in producing a tunable single mode laser, let alone a tunable single mode laser as called for in Claim 1.

In view of the foregoing, the Examiner's rejection of Claim 1 as being obvious over Leckel et al. in view of Dhuler et al. is improper and should be withdrawn. Claim 1 should be found allowable.

Claims 2-12 and 14-27 depend from Claim 1 and are patentable for the same reasons as Claim 1 and by reason of the additional limitations called for therein. For example, Claim 5 is additionally patentable by providing that the at least one microactuator includes a microactuator coupled to the reflective element for causing angular movement of the reflective element. Claim 6 is additionally patentable by providing that the at least one microactuator includes a microactuator coupled to the reflective element for rotating the reflective element about a pivot point. There is certainly no disclosure in Dhuler et al. of such a microactuator, let alone a suggestion as to how such a microactuator could be developed and used to provide a single mode tunable laser. Claim 7 is additionally patentable by providing that the pivot point is spaced apart from the microactuator. Claim 9 is additionally patentable by providing that the at least one microactuator includes a first microactuator coupled to the reflective element for rotating the reflective element about a pivot point and a second microactuator coupled to the reflective element for translating the reflective element relative to the diffractive element The additional limitations of Claims 7 and 9 are not suggested or disclosed by the prior art.

Claim 11 is additionally patentable by providing that the at least one microactuator is an electrostatic microactuator having interdigitatable comb fingers. Contrary to the assertion of the Examiner, there is no suggestion or disclosure in Jerman et al. that an electrostatic microactuator having interdigitable comb fingers as disclosed therein would be suitable for use in a thermally actuated microactuator of the type disclosed in Dhuler et al., let alone in a tunable laser of the type called for in Claim 1. In this regard, an actuator with interdigitable comb fingers is electrostatically driven, while the microactuator of Dhuler et al. is thermally actuated. Such principles of operation are quite different and do not permit, as appears to be suggested by the Examiner, a comb driven actuator to be substituted into a thermally actuated microactuator to provide a workable device. There is further no suggestion in Jerman et al. that the microactuator thereof would be suitable for use in a tunable laser, particularly of the type called for in Claim 1.

Claim 28 is patentable by calling for a tunable laser comprising a laser source for providing light with a wavelength selected from a range of wavelengths, a diffractive element spaced from the laser source for redirecting the light received from the laser source, a reflective element spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light to

the laser source whereby the laser source, the diffractive element and the reflective element cause the light to lase at the wavelength, and a rotatable micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating such element to select the wavelength of the light.

The rejection of Claim 28 under 35 U.S.C. §103 is in error because, as discussed above with respect to Claim 1, Leckel et al. fail to provide the requisite suggestion/motivation to provide a laser system of the type called for therein having, among other things, at least one microactuator coupled to one of the diffractive element and the reflective element and Dhuler et al. do not provide the requisite motivation to add a microactuator to a laser system of the type disclosed in Leckel et al. Even if Leckel et al. and Dhuler et al. are combined in the manner suggested by the Examiner, Dhuler et al. does not suggest or disclose a rotatable (emphasis added) micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating such element to select the wavelength of the light.

Claims 29-30 depend from Claim 28 and are patentable for the same reasons as Claim 28 and by reason of the additional limitations called for therein. For example, Claim 29 is additionally patentable by stating that the micromechanical actuator includes a rotatable micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating and translating such element. Neither Leckel et al. nor Dhuler et al. suggest or disclose an actuator, including a rotatable micromechanical actuator, for rotating and translating one of the diffractive element and the reflective element. Claim 30 is additionally patentable by calling for an additional microactuator coupled to such element for translating such element.

Claim 37 is patentable by calling for a tunable laser of the type called for therein having, among other things, a rotatable electrostatic microactuator coupled to the reflective element for rotating the reflective element about a pivot point spaced apart from the microactuator to select the wavelength of the light. Neither Leckel et al. nor Dhuler et al. suggest or disclose a microactuator coupled to the reflective element for rotating the reflective element. Such references also do not disclose an electrostatic microactuator, let alone a rotatable electrostatic microactuator. In addition to the foregoing, neither Leckel et al. nor Dhuler et al. suggest or disclose a rotatable microactuator coupled to the reflective element for rotating the reflective element *about a pivot point spaced apart from the microactuator* (emphasis added).

Claims 38-30 depend from Claim 37 and are patentable for the same reasons as Claim 37 and by reason of the additional limitations called for therein.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

In view of the foregoing, it is respectfully submitted that the claims of record are allowable and that the application should be passed to issue. Should the Examiner believe that the application is not in a condition for allowance and that a telephone interview would help further prosecution of this case, the Examiner is requested to contact the undersigned attorney at the phone number below.

Respectfully submitted,

DORSEY & WHITNEY LLP

By

Edward N. Bachand, Reg. No. 37,085

Four Embarcadero Center, Suite 3400
San Francisco, CA 94111-4187
Telephone: 650-494-8700

1055295

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the specification:

The paragraph beginning at line 13 of Page 27 has been amended as follows:

Second microactuator or motor 508 for moving collimating lens 503 is preferably a MEMS-based microactuator of any suitable type and more preferably an electrostatic microactuator. A linear electrostatic microactuator can be utilized and constructed in the manner discussed above with respect to first microactuator 507. The details of a preferred linear electrostatic microactuator 508 for tunable laser 501 are shown in FIG. 13, where like reference numerals have been used to describe like components of microactuators 508 and 507. Microactuator 508 shown therein is formed from a planar substrate 586 substantially similar to substrate 526. A plurality of first and second comb drive assemblies ~~586~~587 and 588, which are preferably linear comb drive assemblies, are carried by substrate 586 and arranged on the substrate in first and second sets 591 and 592. Each of the first and second comb drive assemblies 587 and 588 includes a first comb drive member or comb drive 593 mounted on substrate 586 and a second comb drive member or comb drive 594 overlying the substrate 586. At least first and second spaced-apart suspension members or spring members 596 and 597 are included in microactuator 508 for supporting or suspending the second comb drives 594 over the substrate 586 and for providing stiffness to the second comb drives 594.

The paragraph beginning at line 17 of Page 54 has been amended as follows:

In another embodiment of the tunable laser of the present invention, micromechanical means that includes at least one microactuator is provided for rotating and ~~reflecting~~translating one of diffraction grating 504 and reflector 506 for selecting the wavelength of output beam 150. In one preferred embodiment, at least one microactuator is provided for rotating reflector 506 relative to diffraction grating 504 and for translating the reflector 506 relative to the diffraction grating. Such a tunable laser is substantially identical to tunable laser 651 and includes a microdevice 851, substantially similar to microdevice 652, shown in FIG. 25. Like reference numerals have been used to described like components of microdevices 652 and 851. Microdevice 851 is preferably

a balanced microdevice and includes a first microactuator 852 substantially similar to first actuator 653 of balanced microdevice 652.

The paragraph beginning at line 7 of Page 55 has been amended as follows:

The inner radial end portion 698a of the spring member 698 of each of first and second springs 664 and 666 is coupled or secured to substrate 526 by means of a substantially ridged shuttle member or shuttle 856 and first and second suspension beams 857. Translation shuttle 856 is substantially similar in construction to rotation shuttle 853 and extends from the inner radial extremity of first spring 664 to the inner radial extremity of second spring 666. The shuttle 856 has a linear central portion 856a which extends perpendicular to reflector 506 and has a length ranging from 200 to 1500 microns and preferably approximately 1000 microns. A suspension beam 857 is secured to each end of central portion 856a and preferably extends perpendicular to the central portion 856a. The other end of each suspension beam 857 is secured to a mount 858 anchored to substrate 526. Each of the suspension beams has a length ranging from 50 to 500 microns and preferably approximately 200 microns and a width ranging from three to 10 microns and preferably approximately four microns. Translation shuttle ~~586~~856 and suspension beams 857 are each formed from top wafer 668 and are suspended above substrate 526 by air gap 671.

In the claims:

Amend the following claims as indicated:

1. (Twice Amended) A single mode tunable laser operable over a range of wavelengths comprising a laser source for providing light ~~along an optical path~~ with a single wavelength selected from ~~a~~the range of wavelengths, a diffractive element ~~positioned in the optical path and~~ spaced from the laser source for redirecting the light received from the laser source, a reflective element ~~positioned in the optical path and~~ spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back ~~along the optical path~~ to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light ~~along the optical path~~ to the laser source whereby ~~the optical path created by~~ the laser source, the diffractive element and the reflective element ~~causes~~cause the light to lase at the wavelength, and at least one microactuator coupled to one of the diffractive element and the reflective element for ~~moving~~causing angular

movement of such element to ~~select~~permit selection of the single wavelength of the light from the range of wavelengths.

2. (Amended) The tunable laser of Claim 1 wherein the ~~optical path extends~~light travels from the laser source to the diffractive element and then to the reflective element along an optical path length and wherein the wavelength has a half wavelength and can be selected from ~~a~~the range of wavelengths, the at least one microactuator moving said one of the diffractive element and the reflective element so that the optical path length equals an integer number of half wavelengths of the selected wavelength ~~over the range of wavelengths~~.

5. (Amended) The tunable laser of Claim 1 wherein the at least one microactuator includes a microactuator coupled to the reflective element for ~~moving~~causing angular movement of the reflective element.

8. (Amended) The tunable laser of Claim 6 further comprising means ~~carried by the substrate~~ for translating the reflective element relative to the diffractive element.

13. (Twice Amended) A tunable laser comprising a laser source for providing light ~~along an optical path~~ with a wavelength selected from a range of wavelengths, a diffractive element ~~positioned in the optical path and~~ spaced from the laser source for redirecting the light received from the laser source, a reflective element ~~positioned in the optical path and~~ spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back ~~along the optical path~~ to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light ~~along the optical path~~ to the laser source whereby ~~the optical path created by~~ the laser source, the diffractive element and the reflective element ~~causes~~cause the light to lase at the wavelength, at least one microactuator coupled to one of the diffractive element and the reflective element for moving such element to select the wavelength of the light and a counterbalance coupled to the at least one microactuator and the one of the diffractive element and the reflective element for inhibiting undesirable movement of the one of the diffractive element and the reflective element in response to externally applied accelerations to the tunable laser.

28. (Twice Amended) A tunable laser comprising a laser source for providing light ~~along an optical path~~ with a wavelength selected from a range of wavelengths, a diffractive element ~~positioned in the optical path and~~ spaced from the laser source for redirecting the light received from the laser source, a reflective element ~~positioned in the optical path and~~ spaced

from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back ~~along the optical path~~ to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light ~~along the optical path~~ to the laser source whereby the ~~optical path created by the~~ laser source, the diffractive element and the reflective element ~~causes~~cause the light to lase at the wavelength, and a rotatable micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating such element to select the wavelength of the light.

30. (Twice Amended) The tunable laser of Claim ~~28 wherein the micromechanical actuator includes~~29 further comprising an additional microactuator coupled to such element for translating such element.

37. (Amended) A tunable laser comprising a laser source for providing light ~~along an optical path~~ with a wavelength selected from a range of wavelengths, a diffractive element ~~positioned in the optical path and~~ spaced from the laser source for redirecting the light received from the laser source, a reflective element ~~positioned in the optical path and~~ spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back ~~along the optical path~~ to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light ~~along the optical path~~ to the laser source whereby the ~~optical path created by the~~ laser source, the diffractive element and the reflective element ~~causes~~cause the light to lase at the wavelength, and a rotatable electrostatic microactuator coupled to the reflective element for rotating the reflective element about a pivot point spaced apart from the microactuator to select the wavelength of the light.